

STUDY OF ANIONS AND CATIONS IN AEROSOLS PARTICULATES AT CHAMAN REGION OF BALOCHISTAN, PAKISTAN.

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ABSTRACT: The basic purpose of this analytical exercise was to determine anions and cations of aerosols, the tiny soil particles suspended in the immediate atmospheric layers at the area of Chaman, Quetta. The level of anions (F^- , Cl^- , NO_2^- , NO_3^- , SO_4^{2-} & $C_2O_4^{2-}$) and cations (NH_4^+ , Ca^{2+} , Mg^{2+} , Na^+ & K^+) were determined respectively through the technique of Ion-Chromatography. The results indicated that the atmospheric pollution of the Chaman is increasing as compared to the standard of WHO.

Keywords: Aerosols particulates, anions and cations and Ions- Chromatography.

INTRODUCTION

Balochistan, is a province of Pakistan, borders approximately 900 miles of the Arab line and the Persian Gulf. The capital, and only main city is, Quetta; all the other cities and side areas are underdeveloped. The people of Baloch and Pashtun tribe constitute the two principal ethnosp groups; mixed ethnic actions, mainly of origin of Sindhi set up, the third principal group here in Balochistan. Balochistan is blessed with different type of minerals; it is the second major producer, after Sind province, of natural gas. Traditionally, the people of Balochistan, mostly, adopt farming as an occupation, but in coastal regions, fishing is a potential source of their income.

Chaman is the capital of Qilla Abdullah District, Balochistan, Pakistan. It is located at the south of the crossing of frontiers of Chaman, Figure 1, with the Spin Boldak neighbor in the province of Kandahar of Afghanistan. Chaman has a population of 100,000[1].

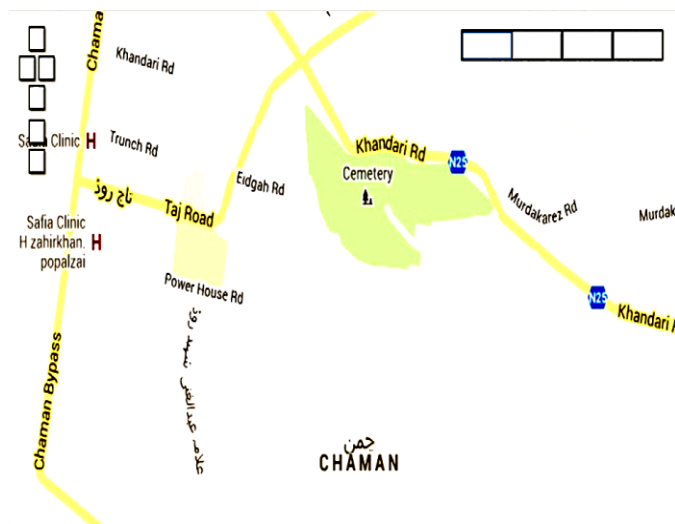


Figure-1. Map of Chaman.

The chemistry of precipitation is the evidence of chemical consistency of the atmosphere in the course of time. Precipitation is mainly influenced by means of the man made

sources producing NO_x, Oxides of Sulphur and other acidic chemicals like bicarbonates, carbonates and NH₃, also influence the final acidity of the deposit.

The emission of the pollutants of the air is burgeoning in much of Asian south and its adjacent areas [2], including China [3]. Research aimed in this perspective is a systematic way to find out composition of precipitation, regularly carried out in Europe and North America [3], but it is limited in other parts of the world [4], particularly in the rural areas of the tropical regions [5]. The composition of rainwater is valid for the validation of the total data of Global Chemistry Transport Models (GCTMs) [6] and helps in determining oxidized nitrogen compounds and total recycling of the compounds of sulphur, the dust of the ground, etc. Research on the chemical consistency of rain water in various parts of India were brought back and saved in literature. Rolling programs of measurement studies of inspection network on basic atmospheric pollution were handled by Background Air Position Monitoring System (BAPMoN) of the total Global Atmospheric Watch (GAW) programs of control of chemistry precipitation by the Indian Institute of Tropical Meteorology (IITM) Pune [7], and collaboration of Indo-Swedish on the chemistry of the atmosphere [8]. These contributed to the database of chemistry of rainwater for the considerable periods.

In case of this study, the data of Chaman, Quetta, mainly of emission of vehicles and the four brick kilns, in the region is given in the paras below.

Mineral dust, of the natural sources and anthropogenic sources is the component of the atmospheric aerosol which are most abundant with reference to the RHE dry mass of aerosol, adding more than 50% of all the total load of aerosol particulates [9-10]. Consequently, its load on the climate system and threat to atmospheric environment is vital, which shows an essential need of research on the origin of the aerosols of dust, their loader-gates in the atmospheric layers and the hydrological cycle. Substantial seasonal alterations of the atmospheric load of dust, varying the speed of wind and the dry conditions were also seen. It is identified that the main release of dust and the atmospheric load of dust occur in hot seasons.



Figure-2 Brick kiln On the way near to Chaman , Balochistan.

For instance, the suspended dust of the various sources above the Sahara, the Arab peninsula and of South-West Asia are generally observed in summer and the activity of storm of dust of maximum above the East Asia is observed in spring [11].

The mineral aerosols of dust degrade air quality and compromise the health of the people [12]. They are also a source of Fe which can cause effects on hydrological cycles, adding to oceanic catch of C [13].

Moreover, mineral dust has a major impact on the climatic systems. While dispersing and it absorbs the solar and infrared radiation and varies the structure and rates of evaporation of the droplets of cloud [14]. It has influence on the optical and electrical characteristics of the clouds by increasing the reflectivity and total cross section area of droplet; [15] It also causes suppression [16-17] or reinforcement [18] precipitation in a particular area. The indirect effect of aerosol is a sector of the high uncertainty in the climatic system [19-20].

Feedbacks are processes in which the production of a system has an impact on its entry, with the result that a cyclic chain of the actions or reactions is produced. The negative one and the positive reactions can occur, the old acts to maintain the actual position of a system, whereas this last tends to produce a change of racing. The relations between the atmospheric processes and the aerosols of dust are bidirectional, so that while the atmosphere can have a major impact on the training of dust and its three-dimensional distribution, of the aerosols of dust consecutively can have impacts on the atmosphere. Indeed, the radiative effects of mineral dust have an impact on atmospheric dynamics. For example, of the radiative effects of Saharan dust Asian monsoon [21-22] and the monsoon of West Africa [23-24] were identified. It was also noted that to force radiative direct by mineral dust which change the temperature at atmospheric stability due to which the speed of wind influenced in the lower temperature [25].

The previous studies indicate that the mineral aerosols of dust cool the external and lower atmosphere, and heat the layer of dust above during the day [26], contributing of this fact to establish a more stable atmosphere [27] and consequently the speed of the wind close to decreasing surface [28-29] but increasing winds in the layers above. Such a disturbance in the weather fields can change the emission and the transport of the particles of dust [30]. This work indicates data of chemistry of precipitation, with objectives to establish the chemical composition of rainwater and the repercussions of the puffed up air dusts and the gases, which will be the broad outline given for other young researchers and scientists in the future for the development of the field of Rainwater Chemistry. Further, this work is an effort to recapitulate the current comprehension of the rain water aerosol particulates which impact on the microphysics of cloud, as well as its effects of feedback on atmospheric characteristics.

2. EXPERIMENTAL

The samples were collected in Chaman in the area of Balochistan before January 2014. The samplers were equipped with the supports with a filter of polycarbonate open-face. The Field Blanks were given for all the specific sites of sampling and were considerably observed for the purpose of calculation. The filters charged were preserved in the boxes of Petriclean of millipore and stored in refrigerators during the time of sampling to reduce to the maximum losses of the evaporation and volatilization. During the execution of the experiment the following materials were employed; HNO₃. containers out of plastic, pH meter and meter of conductivity, meter of turbidity, ion – instrument chromatographic and analyzer of carbon.

Ion analysis

The aliquot parts of a quartz fibre filter (3 punches of 10 millimetres) were extracted for minute 20 by ultrasounds in 3.5 ml from ultra pure water. The anions (F⁻, Cl⁻, NO₂⁻, NO₃⁻, SO₂²⁻ and C₂O₄²⁻) and the cations (Na⁺, K⁺, NH₄⁺, Mg²⁺ and Ca²⁺) were analyzed with the chromatography of ion. Details of the analytical method were provided [31]. An automatic sampler (Sparke Holland Marathon) was used to introduce various samples instead of the columns of concentrator of trace. The Field Blanks were given for all the sampling sites and were given due consideration for calculation procedure. Total C was finalized by the carbon analyzer and in the same way the pH, conductivity and turbidity were measured by pH meter, the meter of conductivity and the meter of turbidity as shown in the table 1.

3. RESULTS AND DISCUSSION

From the data mentioned in Table-1, it is observed that the concentration of alkalinity is 6.4 owing to lower values of temperature and moisture, which raised efforts for the neutralization of the acid while high level turbidity was also observed with high temperature. One expects that sulphates are the primary emissions of the diesel traffic due to the diesel fuel top of sulphur contents used in this area. One also expects that a substantial part of sulphates of the diesel combustion of the traffic and of coal either presents in this factor.

Table-1. Physical Parameters of Aerosols particulates in of Rainwater of Chaman.

No.	Acc #	Sample Collected	# of Events	TOC (mg/l)	Cond. (us/cm)	pH (lab)	Turbidity (NTU)
1	001	01/09/14	1	0.7865	51.3	6.94	1.83
2	002	01/10/14	1	0.7764	40.9	6.92	0.79
3	003	01/ 11/14	1	0.7654	20.5	5.95	0.78
4	004	01/12/14	1	0.437	37.4	5.97	1.09

Emissions from diesel were recognized by the concentrations of CO, Iron, Calcium ,Potassium, and Sulphate ions. At present, the high Sulphur diesel fuel is being constantly used in this area, resulting the direct emission of SO₃ and the great concentrations of CO from these diesel engines of obsolete design. Some secondary factors are also linked to these emissions.

Currently, iron comes probably by use of braikes, whereas lubricating oil combustion is the source of calcium. In carbonaceous materials of the current study, soluble ions, and the trace elements were analyzed. Principal components, for example, of the dust of ground, mineral components of the fly-ashes, the abrasion and there suspension of street, the dust of the activities of construction, etc., based on the compounds of silicon and aluminum and the moisture of aerosol were excluded. Sum of these components, which were analyzed, which showed the composition of aerosol without insoluble components of mineral material. The insoluble components of mineral material are generally nouveau riches in aerodynamic diameter of the >2 μm fraction of size and are the typical components of the rough fraction of aerosol [15]. The moisture of aerosol usually is not analytically given and approximately 20% not comprised concentration out of sulphate of ammonia in aerosol. The sulphate is dominating

in this factor probably because of the its contribution in making sulphates of potassium. Like smoke, the particles of KCl can interact with gaseous acids to make K₂SO₄ and high chloride KNO₃ . This can be emitted mainly by burning hot coal in power stations and out of ovens with bricks [32]. Unlike sulphates like existing sulphates of potassium gained by burning of biomass, one expects that sulphates of the coal combustion are secondary factors of aerosol emission. Since the brick kilns employ a mixture of easily available biomass and powder coal found there[33- 34]. Besides these sources, coal is an important energy source to cook and heat in this area. All the profiles of source have loading of calcium, which depicts that all the sources can be connected to dust of road and materials in the crust.

The equipment in the crust did not bring back a physically reasonable solution, it could not mention a single factor as well. Consequently, a model with the given six factors brought back the solution in a reasonable way. Faiz and Gautam[35] announced that the poor maintenance of vehicle, lubricant abuse, and adulteration of the petrol and oils Diesel is a constant problem in vehicles which are in service in South Asia and could have probably worsened levels of emission (Table-2 and Figure-3) shows that NaCl, CaSO₄,

Table-2. Anions and Cations of aerosols particulates of rain waters of Chaman through Technique of Ion- Chromatography.

No.	Acc #	Sample Collected	# of Events	NH ₄ ⁺ (ug/l)	F ⁻ (ug/l)	Cl ⁻ (ug/l)	NO ₂	NO ₃ ⁻ (ug/l)	SO ₄ ²⁻ (ug/l)	C ₂ O ₄ ²⁻ (ug/l)	Ca ²⁺ (ug/l)	Mg ²⁺ (ug/l)	Na ⁺ (ug/l)	K ⁺ (ug/l)
1	001	01/09/14	1	1410	<.10	0.11	<.01	<.01	<.10	<.10	1426	86	403	143
2	002	01/10/14	1	2622	<.10	<.10	<.01	<.01	<.10	<.10	5473	272	1889	914
3	003		1	3065	<.10	<.10	<.01	0.04	<.10	<.10	5084	201	1959	629
4	004	01/12/14	1	3034	<.10	<.10	<.01	<.01	<.10	<.10	3085	130	933	365

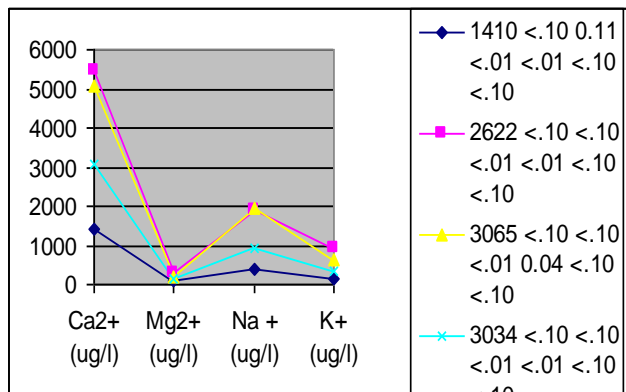


Figure-3. Ionic components of aerosols particulates.

MgSO₄, MgCl₂, HNO₃, NH₄NO₃, NH₄SO₄ and (NH₄)₂ SO₄ are prevalent combinations of species.

Incomplete dissolution of carbonate minerals such as dolomite and calcite is the prime reason casting effect on the composition of rainwater. The pH value from 5.95 to 6.94 with has weighted mean worth of 6.2. The indicated alkalinity of rainwater was due to high loading of alkaline particulates in the atmosphere, which are mostly found in Pakistan. The suspended particulates which are enriched with carbonates of gold, bicarbonates of calcium, etc tend to buffer the acidity of rainwater originated from H₂SO₄ and HNO₃ etc . NH₃ (in the forms of NH₄ +) so acts as important buffering agent in the atmosphere. Indeed, mineral dust aerosols regularly cover long distances of intercontinental year scale [35] and are transported full circuit around the globe [36]. The schematic diagram of the interactions of aerosols is given below.

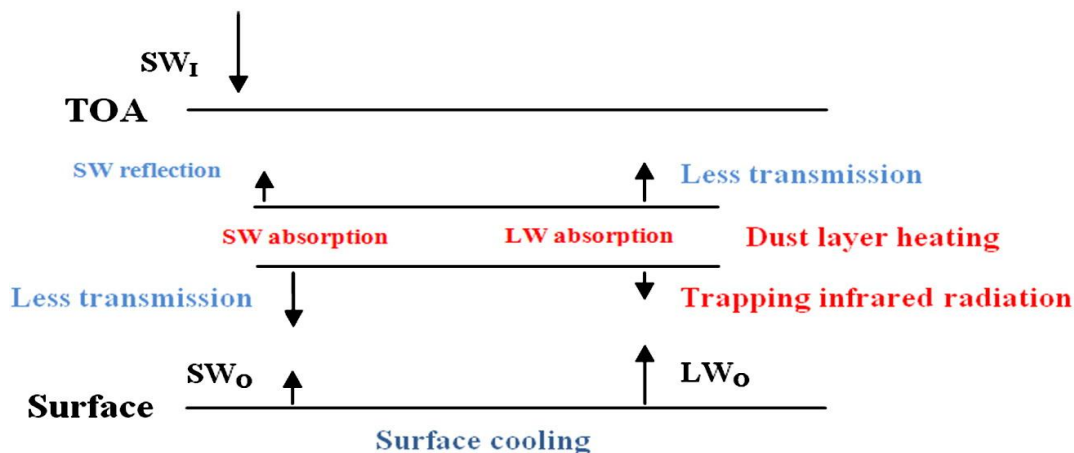


Figure-4. Schematic diagram of the interactions of aerosols.

A schematic photograph of the interaction of the aerosols of dust with various parts of the atmosphere, to force radiative direct, is clearly defined in Figure-4. The short waves and absorption of long waves by aerosols of dust increase the rate of heating of the layer of dust. Note that the mixed aerosols, which are composed of mineral dust and other materials can have higher (dust + soot) [38-39] and lower (dust + sulphate) properties of absorption. The combination of the absorption and the retro diffusion of the radiation of short waves entering tiny room and the solar radiation reaching surface, can decrease, by this fact, the rate of heating of the atmosphere below the layer of dust. On the other hand, by imprisoning the leaving radiation long waves, force radiation of dust on surface is always positive [40], suggesting that mineral dust heats surface during one night when it acts one on the other only with the radiation long waves [41].

3. CONCLUSION

The investigation into the chemical consistency of rainwater was done over one year period at Chaman in area of Quetta, Balochistan, which shows major contribution in the area of rainwater chemistry. Observations show that the rainwater is alkaline here, indicating that its acidity is neutralized by the materials found in the ground which include Mg, NH_4 and the ions having their roots in salts. Compounds of Sulphur and Magnesium have major contribution in this regard. Atmospheric degradation is a constantly increasing problem in Chaman, Pakistan, which is generally characterized with high ambient concentrations of the particulate pollutants having various materials in it. Comparatively, other factors measured while carrying out this research of pollution have comparatively less contributions, including smoke out of wooden material, vegetative refuse, natural gas etc. Combustions of coal and the emissions by diesel engines are the two greater sources which contributed broadly to this menace. Aerosols of Chaman also have significant contribution of biomass, industrial quantities, and emissions at load of the vehicle. Among the ions, Ca transforms the highest levels followed by SO_4 and magnesium indicating Ca incorporation of the equipment of ground into rain, which depicts a significant continental influence. The analysis of comparison and correlation between the principal composition of ion and other sites selected indicate that the composition of

rainwater ions are influenced considerably by terrestrial sources rather than of the man-made sources. An outline of the distribution of mineral dust in the whole world, its direct, semi-direct and indirect effects, as well as its impacts on the dynamics of atmospheric state. The mineral aerosols of dust play a key function in the climatic system of the ground and the hydrological cycle by their radiative effects on clouds.

RECOMMENDATIONS

- It is alarming that coal consumption in Chaman is in very huge number in winter season, therefore the public should be aware of its negative impacts.
- Also emission of vehicle diesels and brick kilns can create problem to environment, therefore the Government should take serious precautionary measurements particularly with reference to plantation and forestry.
- The Govt. of Pakistan should make efforts for educational uplift and eradication of illiteracy particularly from Balochistan.

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